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"A Method and A System for Telecommunication"
(Menetelmä ja järjestelmä televiestintään)

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A Method and A System for Telecommunication

The field of the invention

The invention relates to a method and system for telecommunication and more particularly for the use of telecommunication networks and datacomunication networks.

Background of the invention

Telecommunications have undergone rapid change since the first digital cellular phones entered the market. Digital mobile technologies like GSM can now offer equivalent, if not better voice quality than the normal fixed line telephone. This, in addition to the obvious advantage of mobility, has been a major reason for the increasing use of cellular telephones. In many cases the cellular phones have become the phones of choice over the fixed line.

In addition to higher cellular phone use in offices, another key trend is the introduction of many new products for IP (Internet protocol) Telephony systems. This is in response to the number of home users who have started using IP Telephony systems to save on long distance calls.

Summary of the invention

Most users only want one phone number that incorporates a range of useful features supported both in the phone and the cellular network, like a telephone directory, short messaging, multiparty services, data calls, call barring, call forwarding etc.More services are needed. The cost of mobile telecommunication in public environment is sometimes high. Capability of the Internet services to the mobile end-users is low. Quite a many different end-user terminals are needed for different connections and services. The services within the office for one end user terminal are limited. Some calls can be connected locally.

In the past, organisations have deployed separate networks to handle traditional voice, data, and video traffic. Each with different transport requirements, these networks were expensive to install, maintain, and reconfigure. Furthermore, since these networks were physically distinct, integration was difficult if not impossible, limiting their potential usefulness.

The Nokia Wireless Intranet Office (WIO) is a combination of the revolutionary Internet Telephony technology with field-proven GSM systems. The Nokia WIO solution is focused on offering standard GSM-based telephone systems in the office environment so that intra-office calls can be routed through the office Intranet. Outside the office premises, calls are routed normally through the GSM network. The use of a wireless LAN connection for voice over the Internet telephone conversations holds tremendous potential for opening new applications for this technology.

WIO system is a mobile network based on GSM and IP networking. Connection to outside of WIO, mobile and fixed telephone world for example, is implemented using public GSM network interfaces. Connection to Intranet / Internet world is implemented using H.323 architecture. H.323 is a comprehensive ITU standard for multimedia communications (voice, video, and data) over connectionless networks that may not provide a guaranteed quality of service. IP based networks are good examples of such networks.

The Wireless Intranet Office (WIO) system is in essence a Virtual Private Network (VPN) for Business Office Services. WIO provides telecommunication services over TCP/IP based data network, which may be a simple LAN or a complex interconnected corporate network.

Development of WIO not only makes total employee mobility easier to businesses, but it can be achieved at a cost comparable to traditional cordless technologies.

The main focus area for WIO is the office environment. There are new ways of bringing basic services to the end user that enable mobile phone to be the only telecommunication device that are needed in the office, on the road, and at home.

Especially in their offices people have used to get a great deal of services at very low tariffs. The great deal of services is reality in cellular environment, but low tariffs are usually not even in basic services. Basically, this is due to the nature of the cellular communications: telecommunication in public environment. Development of customer specific features is slow and expensive both in the terminals and in the infrastructure.

Using applicant's approach to Internet telephony systems by no means excludes the possibility to use other than mobile telephone systems for communicating via IP, but it does give a wider choice of user segments to the operator.

Another target of the Wireless Intranet Office system solution is to bring added value to Nokia 9000 Communicator type of products having a display for viewing documents. This is realised by bringing emerging personal communication capabilities of Internet to end-users. The very first added value is the cheaper price tariff of the basic and supplementary telecommunication service. To enable this and other new services and applications, the focus must be on open interfaces, integration of computing and telecommunication, and independent software vendors.

With WIO the cellular operator can expand capacity in the network without investing huge sums of money in transmission in the office environment. The business users generally represent the best market segment having higher phone usage. The Wireless Intranet Office product concept promotes the use of cellular phones anywhere and anytime.

The benefits of WIO can be seen in attractive multimedia services with very competitive pricing schemas. The basic services become cheaper for end-users through new access and delivery technologies making existing customers more satisfied. It encourages new end-users to take the first

step to adopt cellular technology and cellular phones. For operators, new value-added services, new product delivery channels and totally new business opportunities will open.

WIO also realises the total mobility concept with wireless and fixed convergence. This is based on convergence of digital cellular system technology and emerging communication technologies in computer networks, namely voice over IP. Voice over IP offers several new services for the end user, for example, the bridging of voice, data and video conferencing to the phone in a most elegant way or adding new billing and pricing schemes for operators and ISP's.

WIO can also be seen as a solution that will meet the growing demand for integration of PBX and internetworking technology targeted at providing enhanced and lower cost voice communication for businesses through the integration of voice and data networks.

IP Telephony allows organisations and individuals to lower the costs of existing services, such as voice and broadcast video, while at the same time broadening their means of communication to include modern video conferencing, application sharing, and whiteboarding tools. IP Telephony blends voice, video and data by specifying a common transport, IP, for each, effectively collapsing three networks into one. The benefits are easy to see like increased manageability, which means also better service to the customers. Lower costs through faster handling of calls, also the call charges are reduced. A new breed of collaboration tools, intelligent routing for the right person and increased productivity are received. Possible applications for IP Telephony include areas like telecommuting, real-time document collaboration, distance learning, employee training, video conferencing, video mail, and video on demand.

1.1.1.1.1 Glossary

AGW A-internet gateway provides traffic routing between G.703 interface and the IP network.

BSS Base Station Subsystem.

Call Point-to-point multimedia communication between two H.323 endpoints. The call begins with the call set-up procedure and ends with the call termination procedure.

Endpoint An H.323 terminal, Gateway, or MCU. An endpoint can call and be called. It generates and/or terminates information streams.

Gatekeeper The Gatekeeper in H.323 is defined as an entity on the LAN that provides address translation and controls access to the local area network for H.323 terminals, Gateways and MCUs. The Gatekeeper may also provide other services like

bandwidth management and locating Gateways. The WGK is an extension to the H.323 gatekeeper.

Gateway An H.323 Gateway (GW) is an endpoint on the network which provides for real-time, two-way communications between H.323 Terminals on the packet based network and other ITU Terminals on a switched circuit network, or to another H.323.

H.323 entity Any H.323 component, including terminals, Gateways, Gatekeepers, MCs, MPs, and MCUs.

Logical channel Logical channel is used to carry the information streams between two H.323 endpoints. These channels are established following the H.245 OpenLogicalChannel procedures. An unreliable channel is used for audio, audio control, video and video control information streams. A reliable channel is used for data and H.245 control information streams. There is no relationship between a logical channel and a physical channel.

H.323 Entity Any H.323 component, including terminals, Gateways, Gatekeepers, MCs, MPs, and MCUs.

ILR Internet location register (ILR) has similarities to VLR and HRL. The main function of ILR is to store information from the cellular phone. This information includes MSISDN, IMSI, TMSI, Kc (air interface ciphering key), RAND (random number and SRES (RAND correspondent). The roaming itself is handled by MSC and for visitors, only the temporary information is saved in ILR.

ISDN gateway IGW supports interworking between WIO and ISDN endpoints. It provides audio format translation.

ISP Internet service provider

ITU International telecommunications Union, standardisation committee

LAC Location area code

MAP SS7 mobile application part

Mixed Multipoint Conference:

A Mixed Multipoint conference (see the following figure 13) has some terminals (D, E, and F) participating in a centralised mode while other terminals (A, B, and C) are participating in a decentralised mode. A terminal is not aware of the mixed nature of the conference,

only of the type of conference it is participating in. The MCU provides the bridge between the two types of conferences.

MCU The Multipoint Control Unit (MCU) is an endpoint on the local area network which provides the capability for three or more terminals and Gateways to participate in a multipoint conference. May also connect two terminals in a point-to-point conference, which may later develop into a multipoint conference. In the simplest case, an MCU may consist only of an MC with no MPs.

MC The Multipoint Controller (MC) is an H.323 entity on the local area network, which provides for the control of three or more terminals participating in a multipoint conference. May also connect two terminals in a point-to-point conference, which may later develop into a multipoint conference. The MC provides for capability negotiation with all terminals to achieve common levels of communications. It also may control conference resources such as who is multicasting video. The MC does not perform mixing or switching of audio, video and data.

MP The Multipoint Processor (MP) is an H.323 entity on the network which provides for the centralised processing of audio, video, and/or data streams in a multipoint conference. The MP provides for the mixing, switching, or other processing of media streams under the control of the MC. The MP may process a single media stream or multiple media streams depending on the type of conference supported.

MSC Mobile Switching Centre

RAS channel Unreliable channel used to convey the registration, admissions, bandwidth change, and status messages (following Recommendation H.225.0) between two H.323 entities.

RTP Real-time Transport Protocol

RTP Session For each participant, a particular pair of destination Transport Addresses (one Network Address plus a TSAP identifier pair for RTP and RTCP) defines the session. The destination Transport Address pair may be common for all participants, as in the case of IP multicast, or may be different for each, as in the case of individual unicast network addresses. In a multimedia session, the media audio and video are carried in separate RTP sessions with their own RTCP packets. The multiple RTP sessions are distinguished by different transport addresses.

TAPI 3.0 TAPI 3.0 is an API that supports convergence of both traditional PSTN telephony and telephony over IP networks.

Terminal An H.323 Terminal is an endpoint on the local area network which provides for real-time, two-way communications with another H.323 terminal, Gateway, or Multipoint Control Unit. This communication consists of control, indications, audio, moving colour video pictures, and/or data between the two terminals. A terminal may provide speech only, speech and data, speech and video, or speech, data and video.

WIO Wireless Intranet Office

WGK The WIO gatekeeper provides registration, mobility management, and certain radio resource and call control management services to the WIO entities. See Gatekeeper.

VPN Virtual Private Network

Zone A Zone, see the following figure, is the collection of all terminals (Tx), Gateways (GW), and Multipoint Control Units (MCU) managed by a single Gatekeeper (GK). A Zone includes at least one terminal, and may or may not include Gateways or MCUs. A Zone has one and only one Gatekeeper. A Zone may be independent of LAN topology and may be comprised of multiple LAN segments which are connected using routes (R) or other devices (FIG. 14).

Brief description of the enclosed drawings

Figure 1 shows the concept of WIO integrated to normal GSM network.

Figure 2 shows Media Convergence: Voice, Data, and Video.

Figure 3 shows the scope of the H.323 recommendation.

Figure 4 shows how these core functions fit together with WIO access functions.

Figure 5 shows WIO architecture and connections to GSM and PSTN.

Figure 6 shows ILR Software Architecture.

Figure 7 shows the architecture of AGW.

Figure 8 shows the main functional blocks of IGW.

Figure 9 shows WGK Software Architecture.

Figure 10 shows the different Units and their functional parts in Intranet Mobile Cluster.

Figure 11 shows software architecture of IMC

Figure 12 shows interfaces to and from WIO

Figure 13 shows H.323 Mixed Multipoint Conference

Figure 14 shows a description of the zone of the invention.

Detailed description

The basic guidelines in developing WIO is based on the mobile network, like GSM network architecture, and the interfaces between network elements. In Fig.1 the WIO, a local office within a certain base station or base stations under BTS is handling the calls via local intranet or LAN. The LAN is connected through the Intranet and IP to the MSC in order to reach the subscribers outside the office. As it will be understood the number of MSC can be more and they can be connected to other PLMN and PSTN and ISDN networks. The LAN can be connected to other LAN of the same entity in another location and they can connect each other through IP network so that the calls between the subscribers of certain group and in certain area specified by the BTS or BTS's can be handled as intraoffice calls. The basic call management functions as well as GSM data, fax and SMS services are supported in WIO. All the new network elements in WIO are located between A- and Abis- interfaces. One of the WIO elements, the ILR (Intranet Location Register) uses a MAP interface to connect to HLR.

Wireless Intranet Office (WIO) concept provides an integrated office solution for voice, fax and data communications. The concept enables seamless H.323 based voice over IP system integration into GSM based mobile network. WIO provides local switching for *intra* company mobile calls by using company intranet and enables cost-efficient integration of voice and data networks. The ITU standard H.323, is for real-time multimedia teleconferencing over the Internet and corporate Intranets. H.323 is supported by the major hardware and software suppliers providing video and teleconferencing products. Outgoing and incoming calls to/from WIO are routed normally through the MSC. In addition to calls from WIO to external networks (mobile, PSTN), enhanced penetration will increase traffic in the GSM network, when in outside office cells.

WIO is a solution to Internet Telephony with enhanced functionality by offering GSM mobility to "Voice over IP" discussion that is normally related to fixed lines and PC applications. This, combined with the Gatekeeper functionality offers very cost efficient calls for the customers. Local cellular users can talk to other local cellular, wired or PC users using the office Intranet for transmission.

Voice over IP is emerging as a key technology for network consolidation. Users can take advantage of the growing momentum of the Internet and private IP networks to get economical bandwidth and leverage an established, ubiquitous infrastructure. All other alternatives, while having their place in IP networks, do not offer the range of advantages that Voice over IP will be delivering.

1.2 The H.323 standard is most often thought of as the 'Internet' videoconferencing standard, but it is actually designed to support any combination of audio, video and data and be implemented on any LAN protocol (IPX, TCP/IP, etc.).

IP telephony is an emerging set of technologies that enables voice, data, and video collaboration over existing IP-based LANs, WANs, and the Internet. The CTI (Computer and telephony integration) combines computer and telephone technology for special applications. Traditional CTI is an interface between the PBX of the voice network and the data network switch. They are not actually consolidated, but operate in parallel.

CTI is most frequently used in environment where repositories of information, such as databases, must be accessed with each incoming call. This way the person responding to the incoming telephone call has additional information, such as the customer's previous buying history, preferences, or even the geographic location. Computer Telephony Integration responds to the tones of a telephone or a single voice command such as a number.

Specifically, IP Telephony uses open IETF and ITU standards, like H.323, to move multimedia traffic over any network that uses IP -offering users both flexibility in physical media (for example, POTS lines, ADSL, ISDN, leased lines, coaxial cable, satellite, and twisted pair) and flexibility of physical location. As a result, the same ubiquitous networks that carries Web, e-mail and data traffic can be used to connect to individuals, businesses, schools and governments world-wide. Overhead per packet in H.323 are 12 bytes for RTP header, 8 bytes for UDP, 20 bytes for IP and about 1-3 bytes for link-level header and framing.

Today there are standard ways of connecting most switches to most computer system using CTI gateways. Also standard facilities provided by the switches that can be accessed through the application programming interfaces (APIs) provided by the gateways do exist. The most popular interface for single-user telephony applications is the TAPI interface from Microsoft. Also Sun Microsystems' have their own API (JTAPI) which provides a modular set of APIs for building Java-based CTI applications.

In Figure 2 Media Convergence is shown. In a traditional way the Voice, Data, and Video were handled separately but now the different services are handled through the same network as shown in the right side of Fig. 2.

H.323 is an ITU standard for multimedia communications (voice, video, and data) over connectionless networks. H.323 provides for call control, multimedia management, and bandwidth management for point-to-point and multipoint conferences. H.323 mandates support for standard audio and video codecs and supports data sharing via the T.120 standard.

Furthermore, the H.323 standard is network, platform, and application independent, allowing any H.323 compliant terminal to inter-operate with any other terminal. Figure 3 shows the scope of the H.323 recommendation.

H.323 allows multimedia streaming over current packet-switched networks. To counter the effects of LAN latency, H.323 uses as a transport the Real-time Transport Protocol (RTP), an IETF standard designed to handle the requirements of streaming real-time audio and video over the Internet.

The H.323 standard specifies three command and control protocols:

H.245 for call control

Q.931 for call signalling and

The RAS (Registration, Admissions, and Status) signalling function

The H.245 control channel is responsible for control messages governing operation of the H.323 terminal, including capability exchanges, commands and indications. Q.931 is used to set up a connection between two terminals, while RAS governs registration, admission, and bandwidth functions between endpoints and gatekeepers.

For a H.323 based communication system the standard defines four major components: Terminal, Gateway, Gatekeeper and Multipoint Control Unit (MCU).

Terminals are the client endpoints on the network. All terminals must support voice communications; video and data support is optional.

Gateways bridge H.323 conferences to other networks or communications protocols. Gateways are not required if connections to other networks or non-H.323 compliant terminals are not needed.

Gatekeepers perform two important functions: address translation and bandwidth management. These functions help the gatekeeper to maintain the robustness of the network. Gatekeepers also exercise call control functions to limit the number of H.323 connections, and the total bandwidth used by these connections, in an H.323 "zone." One H.323 zone is a collection of all terminals, gateways and multipoint control units (MCU) managed by a single gatekeeper. A Gatekeeper is not required in an H.323 system-however, if a Gatekeeper is present, terminals must make use of its services.

Multipoint Control Units support conferences between three or more endpoints. An MCU consists of a required Multipoint Controller (MC) and zero or more Multipoint Processors (MPs). The MC performs H.245 negotiations between all terminals to determine common audio and video processing capabilities, while the MP routes audio, video, and data streams between terminal endpoints.

Any H.323 client is guaranteed to support the standards H.261 and G.711. H.261 is an ITU-standard for video codec designed to transmit compressed video at a rate of 64 Kbps and at a resolution of 176x44 pixels (QCIF). G.711 is an ITU-standard for audio codec designed to transmit A-law and μ-law PCM audio at bit rates of 48, 56, and 64 Kbps.

Optionally, an H.323 client may support additional codecs like H.263 and G.723. H.263 is an ITU-standard video codec and G.723 is an ITU-standard audio codec designed to operate at very low bit rates.

From the corporate perspective WIO enables company wide telecommunication services provided internally using data communication resources. For public access co-operation with the local telecommunications operator is required.

From the operator perspective, WIO users may share the resources of a public TCP/IP interconnection service, telecommunication networks and end user service access points, but use private local area networks to access the public network side and other users within the company WAN.

New part of WIO is the overall product concept and the elements in it.

The focus areas are homes and offices. In addition to open platforms for value-added and multimedia services, we have been looking for new ways to bring basic services to end-users.

The PBX industry has recognised this problem and is heavily studying the new CTI technology. Companies working on CTI have moved the development of end-user services and applications to computer environment.

WIO core functions can be described by different services that run over TCP/IP. Figure 4 shows how these core functions fit together with WIO access functions.

WIO system may be seen as a new kind of GSM BSS with a WIO specific location register or as an extension to the packed based multimedia communication system specified in ITU-T Recommendation H.323.

WIO includes three different gateways, AGW, IGW and IMC. The gateway function is only one of the functions these components take care of. All the three gateways have different interfaces to separate parts of the GSM or the H.323 network.

The purpose of A-interface gateway (AGW) is to handle communication from WIO to the GSM world through MSC. AGW provides both signalling and traffic routing between WIO and MSC. It thereby forms a BSS interface to the MSC From MSC's point of view WIO looks like one or more BSS's with certain Location Area Codes (LAC). In WIO AGW does not need to include transcoding functions, therefore it can be connected to a Nokia Transcoder (TCSM2) with an A-ter-interface. It is also possible to connect to MSC directly with A-interface.

WIO System is configured, controlled and maintained by special WIO Operation and Maintenance Unit. For that purpose AGW provides an interface which is defined in O&M Unit documentation. The communication between O&M Unit and AGW is always encrypted, just like the signalling between all the WIO components.

AGW collects statistical information of its central transactions and especially of detected failures and disturbances. WIO Gatekeeper elements constantly control the status of other WIO network elements, hence AGW provides responses to those enquiries as well.

The existing WIO external calls are disconnected by MSC. In case of WIO network connection breakdown, AGW closes temporarily also the MSC signalling link.

The performance of AGW depends both on the PC configuration as well as the used LAN (IP stack throughput, Ethernet, etc.). However, one logical AGW can be realised as a cluster of PCs. For example, to support one multiplexed E1 connection, a configuration of two PCs is needed. This creates about 120 traffic channels.

Depending on the configuration of AGW the number of supported voice traffic channels can vary from 70 up to 220 channels.

ISDN / IP Gateway (IGW) handles communication between WIO and the public telephone network. It is basically the gateway that is defined in the CTI concept. IGW has an interface to both MSC and PSTN. From MSC point of view IGW looks like a PBX. Here IGW is used to enable communication mainly from non-GSM H.323 terminal to GSM mobile outside WIO network. It is possible also other way round (from mobile phone to a PC). Only GSM mobile phones can be connected through A-interface to MSC.

IGW supports transcoding between ITU-T standards G.711 and G.723 as well as G.711 and GSM 06.10. The GSM codec is preferred in WIO.

IGW collects statistical information of its central transactions and especially of detected failures and disturbances. The WGK controls the status of IGW and sends the information to the O&M application.

The Intranet Mobile Cluster (IMC) is simulating BSC in the WIO environment. IMC uses LAPD based Q.931 and GSM specific signalling and generates TRAU frames for speech and data for A-BIS interface. It also manages the radio resources and channel configurations, and handles configuration of the BTS. IMC provides GSM data as well as speech conversion to other WIO components, it also detects the need for possible handover and power control actions during a call.

IMC core functionality covers four different tasks:

IMC runs CVOPS with GSM signalling protocols.

IMC runs WIO system control and IP ciphering.

IMC controls the socket –interface towards WGK.

IMC controls socket –interface towards the GSM/IP traffic option on the LAPD server.

IMC has several tasks in the WIO environment. The following list shows the procedures that are supported by IMC:

Registration, connection ciphering and status inquiry.

Cellular procedures specified in GSM recommendations 04.08 and 08.08

Start/stop BTS

Loading of BTS software and BTS HW -database

Configuring of BTS

Tracing BTS faults

Starting/stopping BTS BCCH transmission

Establish a call to/from BTS

Converting IP traffic to G.703 and TRAU frame generation to ABIS side

Receiving and analysing mobile RF measurements to enable handovers

Control mobile phones and BTS power levels

Reporting resource status and

Reporting statistics of the radio network

WIO Gatekeeper (WGK) is the brain of the system. Its main task is to provide call control services to the H.323 endpoints. More than one Gatekeeper may be present and communicate with each other in a proprietary way. WGK is logically separate from the endpoints, however, its physical implementation may coexist with a terminal, MCU, Gateway, MC, or other non-H.323 network device.

WIO Gatekeeper is responsible for all tasks the H.323 standard defines to its gatekeeper as well as call management, mobility management and the address translation functions. In addition to this WGK also gives paging requests to IMCs, checks service profiles and authorisation of WIO services, collects call data records to be forwarded to billing system, collects measurement information from BTSs and offers an interface for the O&M application. WGK also manages all the other WIO components and takes care of PC terminal registration and status handling.

Call management can be defined as the set of functions that enable and control telecommunications between two or more parties. The goal of Call Management in this domain is to provide a scaleable, robust basic infrastructure and to create an extensible platform for advanced services. The basic need for call management arises from need to provide a directory service for IP telephony that can handle dynamic information such a mapping IP addresses and phone numbers to each other.

WGK is able to manage the major different call types, like voice, data, facsimile, SMS and conference call. These calls can be established between a mobile station, PC terminal and a normal telephone, in any combination. Conference call can be established only from H.323 client.

The calls that WGK manages can be divided into two groups: Intranet and external calls. Intranet calls consist of calls that are made either under the same WGK or between subscribers under two different WGK's. External calls, however, describe the calls where one of the subscribers is not in WIO.

The signalling cases are different for various call types. When a phone inside WIO is called, WKG sends a broadcast paging message to each IMC and then routes the call to the right one. In another case, where both subscribers call under same WGK, the WGK checks where the B-subscriber is and sends a Paging broadcast message to each IMC and then routes the call to the correct IMC.

Again, in a situation where a subscriber inside WIO is calling somebody outside WIO, WGK checks the location of subscriber B (a so-called call-screening feature) and then routes the call to MSC.

Mobility management includes tasks like location update and handover. Location update is done each time a new subscriber arrives to the WIO environment. Also non WIO subscribers are allowed to make a

location update in WIO, only their calls will be routed through MSC. The subscriber information is received using the company's ILS system.

A handover request message is sent to WGK by IMC. This message includes a list of the best target cells. A handover can be made inside of WIO or in cases where the subscriber enters WIO from outside or he leaves the WIO environment.

WGK collects statistical information from all transactions made in WIO (i.e. voice and data call, facsimile, SMS, failed call, etc.). This information is then delivered to the network Operation and Maintenance system or to ILR if it is information that is needed by the billing system.

The gatekeeper will certainly not be the bottleneck in the system. One WIO Gatekeeper can handle:

50 simultaneous signalling transactions

500 simultaneous calls

Call establishment in eight seconds

Location Update in 5 seconds and

50 simultaneous Location Updates

Intranet Location Register (ILR) takes care of the directory services in WIO. The purpose of directory service is to provide storage for retrieving MS specific information configured for the WIO system. All the MS's configured to WIO have a permanent entry in the directory service. The corresponding supplementary services supported by WIO are stored there as well. These MS specific settings are valid when the MS is logged into the WIO system.

Furthermore WIO gatekeeper updates the current LAC of each MS within the WIO region into the directory. In this way the directory can provide the right phone number, which is also called directory mapping. ILR is connected to HLR through a MAP interface. The main task for ILR towards HLR is to receive the setting information for supplementary services from HLR.

Network management is needed to monitor network functionality and to manage network services and elements. It can also be used as an integral part of network planning.

WIO combines two different management worlds, data and telecommunication network management. Native solutions are used in each case still trying to keep common core functionality.

There are two different groups that are interested in WIO functionality. First Telecom operators that offer WIO services must control their licensed radio frequencies and control the service availability, accessibility and service quality. Secondly the organisations using WIO must have understanding about the WIO traffic and signalling load in their data network.

Each network that is going to be used for WIO services must meet some basic requirements for network topology and available bandwidth. In a normal telephone network connections are circuit switched and hence the required transmission capacity is reserved. In a packet switched network quality of service is not fully predictable. When new components are added to operational WIO network, a good method to

predict the possible effect upon performance is to simulate the new network configuration with a modelling tool.

WIO has interconnection with different network management environments. Fault reports can be forwarded to Nokia NMS/2000 network management system with Nokia proprietary interface. The interface is the same that has been used to integrate other Nokia Windows NT based management tools with Nokia NMS/2000.

SNMP based interconnection is needed for other than standard GSM network elements. The network management system to be interconnected could for example be the NMS/300.

O&M will be centralised offering well-documented interfaces to management systems. All in such a way that there will be a single O&M Server Gateway that provides access to the Wireless Intranet Office system for other management systems.

All network elements have a configuration file containing static and dynamic information about network topology, internal security and authentication keys, etc. The O&M Server Gateway stores information of network element, configuration, SW versions, statistics, etc. Any network entity can be added or removed from the system anytime, and all the network entities are identified before they are accepted to the system.

Quality of service refers to the nature of the packet delivery service provided, as described by parameters such as achieved bandwidth, packet delay, and packet loss rates. In WIO environment, the gateways and the gatekeeper will both use the QoS properties of a packet switched network.

As the previous chapters explained, WIO can be seen as an entity with three gateways (AGW, IGW and IMC), a gatekeeper and several interfaces to different targets.

The external interfaces are grouped to:

Interfaces between WIO and WIO end-user terminals

Interfaces between WIO and External Public Telecommunication Networks

Interfaces between WIO and WIO Management System

Again, WIO has several end-user terminals that can be called, they are:

Standard cellular phone

H.323 compatible terminal

Dual mode GSM/Wireline terminal

Dual mode GSM/LPRF terminal

This chapter gives a brief introduction to the interfaces that WIO has and offers to the outside world. Figure 5 shows the architecture and all the components that are needed to combine WIO with the GSM network.

In addition to normal GSM network elements like MSC, BSC, HLR, etc. WIO requires some WIO specific network elements that will be placed close to GSM network devices. The following parts of WIO

will be place on the operator site: ILR, AGW, IGW and O&M server. The following paragraphs explain the tasks of these elements in detail.

The main task of ILR is to work as an access manager to the directory services. ILR runs on a Windows NT server based on industry standard Pentium technology. In order to fulfil its tasks well, the server shall provide high-availability, fault-tolerance both on hardware and software level, and fast recovery. For external connections a set of interface cards is needed. Directory Service utilises Internet Locator Server (ILS) that in turn requires Internet Information Server (IIS). Figure 6 shows the detail information.

ILR Interface implements storage and retrieval functions concerning mobile subscriber information managed by ILR. The purpose is to hide all database related details from WIO Gatekeeper so that a change in the underlying storage method would not require any changes in WIO Gatekeeper. Moreover this interface provides coding and decoding of the request from and replies to the WIO Gatekeeper because all the messages transferred on TCP/IP are encrypted.

LDAP Interface provides means to retrieve and maintain MS specific information stored in Directory Service. This information has been gathered from different sources like HLR Interface and IN Interface. The protocol used in the communication with Directory Service is Lightweight Directory Access Protocol (LDAP).

HLR Interface is used to retrieve mobile subscriber's basic information as well as her supplementary service settings from Home Location Register. This is carried out in connection with Location Update that results in updating MS's LAC stored in ILR i.e. the LAC update request from WIO Gatekeeper acts as a triggering event for the HLR retrieval. The actual protocol is MAP.

IN Interface provides means to retrieve subscriber's additional service information from Nokia Mobile IN e.g. Private Numbering Plan enabling the usage of short codes within WIO. This interface is based on Service Management Interface (SMI) provided by IN.

Billing Interface provides means to transfer billing related raw material information into billing system to be post-processed. In this context the local database of ILR acts as an intermediate storage for billing information collected by WIO Gatekeeper. The actual means to transfer data into billing system is to be defined.

WIO A-Intranet Gateway is a PC with a Pentium processor with a set of interface cards. The operating system is Windows NT 4.0.

There are two different ways of implementing AGW depending on the wanted capacity for the system. The main difference in these two systems is in the computing load. The first solution sets the main computing load on relative efficient interface cards that are connected to each other with a fast MVIP bus. The transcoding will be done on a real-time DSP card.

The second solution sets the main computing load on the host computer. There is no DSP processing available and hence the transcoding is performed in an external Nokia TSCM2 unit. The E1/T1 interface

is planned to support 4 E1/T1 connections per card. Therefore, only one interface card per PC is going to be used. This card uses PCI-bus for communication. The Ethernet interface card can be freely chosen.

Figure 7 shows the architecture of AGW. In this solution the main computing unit runs completely on host.

The architecture of IGW (WIO ISDN-Intranet Telephony Gateway) is based on a similar hardware to AGW. In the first phase the solution will be built on a third party gateway that performs the needed functionality. The number of supported E1 cards play the main role in choosing the right architecture for IGW.

There are several alternatives available for the above mentioned platform solutions.

Figure 8 shows the main functional blocks of IGW.

More technical Characteristics of the IGW is enclosed in appendix A.

WIO Gatekeeper is a software packet running on a Pentium based PC. The different blocks in figure 9 have specific responsibilities. Device Management takes care of WIO entities, terminal registration and status handling. It stores all WIO specific and network information to the Device Database.

Mobility Management takes care of Location Update and Handovers. The call management is responsible for call signalling and call management. Charging block collects charging information from all calls, and sends it to the ILR.

Statistic Block collects statistical information and sends it to the O&M server for further performance and fault analysis.

Information about subscribers registered to WGK is stored in WIO's own visitor register. This register could be for example the ILS server in the office LAN.

Intranet Mobile Cluster (IMC) has almost the same functionality as BSC has in the GSM network. IMC controls one or two BTS's and is based on a third generation Nokia BTS.

IMC supports the following features:

Available GSM 900, 1800 and 1900 MHz frequencies

Speech, data and Short Message broadcasting as GSM functions

Discontinuous Transmission (DTX), RF hopping, TRX loop test and BCCH configuration

TRX Loop Test using Radio Frequency Test Equipment

From technical point of view, Intranet Mobile cluster consists of three parts:

Radio Access Part

Data Processing Unit

Intranet Interface Unit

Radio access part

Radio Access Part consists of radio receiver and transmitting unit, E1 interface and a radio access interface unit.

Both Radio receiver and transmitting unit, are standard Nokia Base Station parts, that can be operated in all GSM900, GSM1800 and GSM1900 frequencies.

Data Processing Unit

DPU is a Pentium based NT. The software architecture consists three different units (see figure 10) that have the following responsibilities:

BTS measurement handling

Handover - algorithm and target cell list reporting

Power control - algorithm and function

Radio channel handling

H.323 Gateway functions

Signalling and speech

Speech UDP <--> TRAU conversion

IMC state management

Radio object state management

IMC and radio access fault management

Radio channel configuration management

Figure 10 shows the different Units and their functional parts.

WIO interface Unit

The WIO interface unit is a LAN interface card, which supports for example 10-Base-T or 100-Base-T physical connections. Also the HGW functionality, like transcoding, is included to this unit.

IMC consist of a standard BTS (GSM, DCS1800 or PCS1900), a PC plug-in card with G.703 interface and a BSC simulator software package for Windows 4.0. The software architecture of IMC can be seen in figure 11.

All the interfaces used in WIO are standard interfaces. As figure 12 shows WIO has two separate interfaces towards MSC. One is realised with IGW and the other one with AGW. IGW fulfils the DSS.1 standard requirements by providing layer 2 (LAPD) and layer 3 (Q.931) protocol services.

The MSC interface is compliant with several standards, like E1, 2,048 Mbit/s (based on G.703 and G.704), LAPD (Q.921) and Layer 3 where the standards Q.931 and Q.932 are used.

AGW fulfils the A-interface recommendations of GSM 08.06 standard by providing SCCP/MTP signalling link interface. The MSC interface is compliant with following standards:

- Physical layer: E1, based on G.703 and G.704 standards, 2,048 Mbit/s
- MTP 2-3: ITU-T Q.701-Q.704
- SCCP: ITU-T Q.711-Q.714

The US standard interface T1 can be supported in WIO.

IGW fulfils the DSS.1 standard also towards the PBX or PSTN.

For internal communication interfaces WIO uses WinSock2 and H.323 standard. The transcoding functions exist in IMC, IGW and AGW. WIO Gatekeeper uses H.323 protocol stacks to communicate with other WIO entities: Q.931 for call set-up, RAS channel for registering the WIO entities and H.245 for controlling the capacity and codec issues.

WIO gatekeeper uses H.323 protocol to communicate with other WIO entities in the following way:

- PC terminal and WIO Entities are registered to the WIO Gatekeeper by RAS channel.
- Q.931 channel is used during call establishment.
- During the call H.245 channel is used for capacity, codec and multipoint call control.
- WIO uses Routed Signalling Model based on the H.323 standard. All signalling between WGK and other WIO Elements is encrypted.

The following interfaces are supported in each WIO element:

- LAN interface (10Base-T, 100Base-T, etc.)
- WinSock2
- RTP/RTCP to control voice packet transmission in UDP datagrams

The following list the technical details of each WIO component, as well as the services and features that are supported in WIO. The technical requirements for each WIO component are listed below.

[1] IP Telephony with TAPI 3.0, White Paper, Microsoft Corporation, 1997

[2] Draft revised ITU-T Recommendation H.323 (V2), report from study group 16, May 1997

[3] Computer telephony integration, From Call centre to Desktop, Ovum reports 1997

1.2.1.1.1.1 Technical Requirements

1.2.1.1.2 WIO Gatekeeper

Software Requirements

MS Windows NT 4.0

ILS (Internet location server)

Hardware Requirements

Processor: Intel Pentium MMX 266MHz

Memory: 64 MB

Floppy Disk: 3.5" 1.44 MB

Hard Disk: 1 GB, IDE or SCSI

CD-ROM Drive: Required

Network Adapter: Compatible with normal LAN protocols, like Ethernet, Token Ring, Star

Communication Interfaces

1.2.1.1.3 WIO network interface

1.2.1.1.4 Intranet Location Register

Software Requirements

MS Internet Locator Server (ILS)

MS Internet Information Server (IIS) 3.0

MS Windows NT Server 4.0 or higher

Hardware Requirements

Cluster: Two servers connected with ServerNet or FastEthernet (equivalent) and FibreChannel for high-availability

Processor: 2 x Intel Pentium Pro 200MHz

Memory: 128 MB

Floppy Disk: 3.5" 1.44 MB

Hard Disk: Switched-SCSI, Shared-SCSI or FibreChannel with RAID disk system

CD-ROM Drive: Required

Network Adapter: Ethernet Compatible

Communication Interfaces

MAP towards HLR

WIO network interface

1.2.1.1.5 Intranet Mobile Cluster

Software Requirements

MS Windows NT 4.0

Hardware Requirements

Processor: Intel Pentium II 300MHz
Memory: 64 MB
Floppy Disk: 3.5" 1.44 MB
Hard Disk: 1 GB, IDE or SCSI
CD-ROM Drive: Required
Network Adapter: Ethernet Compatible (10-Base-T or 100-Base-T)

Communication Interfaces

WIO network interface
WIO O&M interface

1.2.1.1.6 A-Interface Gateway

Software Requirements

MS Windows NT 4.0

Hardware Requirements

Processor: Intel Pentium II 200 MHz
Memory: Min. 32MB RAM, preferably 64MB
Hard Disk: 1 GB, IDE or SCSI
CD-ROM drive: Required
Monitor: Required
10/100Base-T Ethernet interface card
2 slots for E1 interface cards

Recommended Configuration

Compaq Proliant 1600 / 1600 R
266-MHz Pentium II (optionally dual processor capability)
128 MB memory
6 slots (2 PCI, 4 PCI/EISA)

Supported Voice Codecs

WIO: GSM 06.10 (Full Rate 16 Kbps)

Communication Interfaces

WIO network interface

WIO O&M Unit interface

GSM A-Interface, GSM 08.06

1.2.1.1.7 ISDN Gateway

Software Requirements

MS Windows NT 4.0

Hardware Requirements

Processor:	Intel Pentium II 300MHz
Memory:	64 MB
Floppy Disk: 3.5" 1.44 MB	
Hard Disk:	1 GB, IDE or SCSI
CD-ROM Drive:	Required

Supported Voice Codecs

E1: 64 Kbps A-law,

T1: 56 Kbps (μ-law according to ITU-T G.711

WIO: G.723.1 and optionally also GSM 06.10

Communication Interfaces

WIO network interface based on H.323

WIO O&M Unit interface

DSS.1 interface

1.2.1.1.8 Services

Security services:

User authentication

Ciphering over-the-air

IMEI checking

Signalling and traffic encryption over IP

Teleservices:

Speech

Short Message service

Facsimile

Data services

Transparent and non-transparent circuit switched data

Data Compression

Supplementary Services

Number Identification Supplementary Services

Calling Line Identification Presentation

Calling Line Identification Restriction

Call Transfer

Call Transfer

Call Offering Supplementary Services

Call Diversion

Call forwarding unconditional (CFU)

Call forwarding on mobile subscriber busy (CFB)

Call forwarding on no reply (CFNRy)

Call forwarding on mobile subscriber not reachable (CFNRc)

Call Completion Supplementary Services

Call Waiting (CW)

Call Hold (HOLD)

Community of Interests Supplementary Services

Private Numbering Plan

Call Screening services

Barring of All Outgoing Calls (BAOC).

Barring of International Outgoing Calls (BOIC).

Barring of Outgoing International Calls except those directed to the Home PLMN Country (BAOC-exHC).

Barring of All Incoming Calls (BAIC).

Barring of All Incoming Calls when Roaming Outside the Home PLMN Country (BAIC-Roam).

Conference call (H.323 terminal originated only)

1.2.1.1.9 Features

The following list shows the general system features and the version number of WIO where each feature is planned to be realised:

Speech call (internal and external)			**v1**
Mobile to mobile			
Mobile to PC			
PC to Mobile			
Mobile to fixed			
Fixed to Mobile			
Data call			**v1**
MO and MT		v1	
Transparent and non-transparent	v1		
Data compression			v1
Direct call			v2
Facsimile			**v1**
Transparent		v1	
G3 supported			v1
SMS			**v1**
Mobile Terminated		v1	
Mobile Originated			v1
Cell broadcasting			v1
Speech codecs			
Full Rate (GSM 06.10)		v1	
Half Rate (GSM 06.20)		v2	
Enhanced Full Rate (GSM 06.60)	v1 (mobile to mobile)		
G.723.1			v1
G.711			v1
Frequency Range			
GSM900			v1

GSM1800			v1	
GSM1900			v2	
Handover				
From WIO to regular GSM	v1 (if MSC controlled call)			
From regular GSM to WIO	v1			
Intra WIO			v1	
Roaming			**v1**	
Roaming control			v2	
Encryption				
Signalling within IP		v1		
Speech within IP			v2	
Speech in air-interface		v1		
Database content			v1	
AGW				
External transcoding TCSM2			v1	
Internal transcoding			v2	
TRAU frame handling			v1	
IP DTX, (discont. speech transm. over IP)		v1		
Signalling conversion H.323 – GSM 08.06		v1		
Management agent			v1	
Traffic and load statistics		v1		
WGK				
WIO component registration (H.225)		v1		
WIO component status handling (H.225)		v1		
WIO component admission handling (H.225)		v1		
Mobility management			v1	
Handover management			v1	
Call control				v1
Call management				v1

TAPI 3.0 support			v3
Call screening			v1
H.323 gatekeeper			v1
Management agent		v1	
Collects call statistics, supports billing	v1		

IGW

Transcoding (G.711 – G.723)		v1	
IP DTX, (discontinuous speech transmission over IP)	v1		
Signalling conversion H.323 – DSS.1	v1		
Management agent		v1	
Traffic and load statistics	v1		

ILR

Access manager to directory services	v1		
User profile management	v1		
Temporal storage for billing information	v1		
MAP interface to HLR / VLR		v1	
SMI (interface to mobile IN)		v2	

IMC

BTS control and management		v1	
Radio resource control and management	v1		
Radio network control and management	v1		
IP DTX			v1
Trau frame handling		v1	
H.323 transcoder (G.723.1 – GSM 06.10)	v1		

O&M for WIO

Fault management

Alarm monitoring

Alarm forwarding to NMS

Alarm collection and storing

Alarm correlation

Performance management

Measurement data collection and forwarding to NMS

Configuration management

Radio network configuration and management

BTS software archiving and downloading to BTSs

Configuration of WIO entities

Hardware database editing

WIO entity configuration management

WIO entity software management system

Test management

TRX Loop Test

O&M for Data Communication Network

SNMP polling

Trap collection

Claims

1. A method in a telecommunications systems for communicating said method comprising the steps of:
routing calls between the networks,
connecting the terminal via air interface to a mobile network
mapping the mobile network destination address to the network address of another network,
routing at least the calls within a certain group via the computer network accessed by the same specified group.

2. A method in a telecomunications system for communicating said method comprising the steps of
connecting terminal to the base station according to the interface of the first system,
connecting the the traffic transmitted by the terminal from the base station to the translation element (IMC) where the traffic transmitted by the terminal is converted as packet data network protocol (H.323), routing the traffic to the packet data network and further transmitting it connecting element (GK), routing the traffic from GK to the destination according to the query result.

3. A system in a telecommunications system for communication between at least two mobile stations or those and between other terminals connected to the same or different telcommunications network in a telecommunication system, where there are mobile stations, at least one base station, which is provided for communication with the mobile station through radio channel and having a limited operating area, and at least one mobile switching centre provided with the services to the mobile stations and being able to interact with the telephone exchanges and switches, and being able to be connected to the computer networks by itself or through other unit, said system further comprising that the calls between the predetermined subscribers within the predetermined area defined by the base station coverage are routed to a conversion means for converting the specified calls to the another protocol in order to handle the message in said another protocol and checking from the subscriber register the location of the subscribers for routing the call.

4. A system as claimed in claim 3 characterized in that the other network protocol is packet switched, like IP protocol network, e.g. intranet of the company.

5. A system as claimed in claim 3, characterized in that the initiated call is a mobile call using circuit switched protocol.

6. A system as claimed in claim 3, characterized in that the predetermined subscribers are pointed as subscribers of the entity.

7. A system as claimed in claim 3, characterised in that the base station location information is registered in mobile switching services centre or the like, and said location information is updated to the said intranet.

8. A system as claimed in claim 3, characterised in that the base station or a number of base stations or base station controller is pointed to cover the location coverage.

9. A system for telecommunication where there are mobile station connectable through air interface to one of the number of base stations, said base stations being connected operationally to one of the base station controller or the like respectively, said base station controllers being connected to the mobile switching centres or the like for handling the calls in mobile network and between the other networks and mobile switching centres, in said system a number of base stations or base station controllers are grouped to define a predetermined local mobile network, said local mobile network is combined operationally to the company computer network of that location in order to use the company's computer network for routing the calls of the specific coverage area of at least one of the predetermined base stations.

11. A system as claimed in claim 10, characterized in that the calls are analysed on the basis of location update of the mobile station in order to select the routing of the call between the terminals.

12. A system as claimed in claim 10, charatecterised in that the local mobile network is recognised by location area codes in the network management register.

13. A system as claimed in claim 10, characterised in that the subscriber register is loaded from the network management register like HLR, VLR to the local mobile network.

14. A system as claimed in claim 10, characterised in that the calls initiated from and terminated to the local mobile network or the predetermined combination of networks are paged locally.

15. A system as claimed in claim 10, characterised in that the calls under the predetermined local network are handled locally, the destination of the call is checked, according to the information recived from the checking the paging broadcasting messages are sent to each IMC for selecting the IMC through which the call reaches the called subscriber.

16. A system as claimed in claim 10, characterised in that the called subscriber staying outside the local mobile network, the call is routed to the mobile network.

17. A system as claimed in claim 10, characterized in that the location is updated each time a new subscriber arrives to local mobile network.

18. A system as claimed in claim 10, characterized in that local mobile network includes terminals like PC's workstations, mobile phones and fixed terminals.

19. A method for communicating in a communications system including a predetermined area having a subscriber identified access profile, said method comprising the steps of
grouping a number of base stations or base station controllers to define a predetermined local mobile network,
combining said local mobile network operationally to the company computer network of that location in order to use the company's computer network for routing the calls of the specific coverage area of at least one of the predetermined base stations.

(57) Abstract

A method and system for communicating in a communications system including PSTN, ISDN, Mobile network, like GSM, intranets and the Internet and connection between them, a predetermined area having a subscriber identified access profile, said method comprising the steps of

grouping a number of base stations or base station controllers to define a predetermined local mobile network,

combining said local mobile network operationally to the company computer network of that location in order to use the company's computer network for routing the calls of the specific coverage area of at least one of the predetermined base stations.

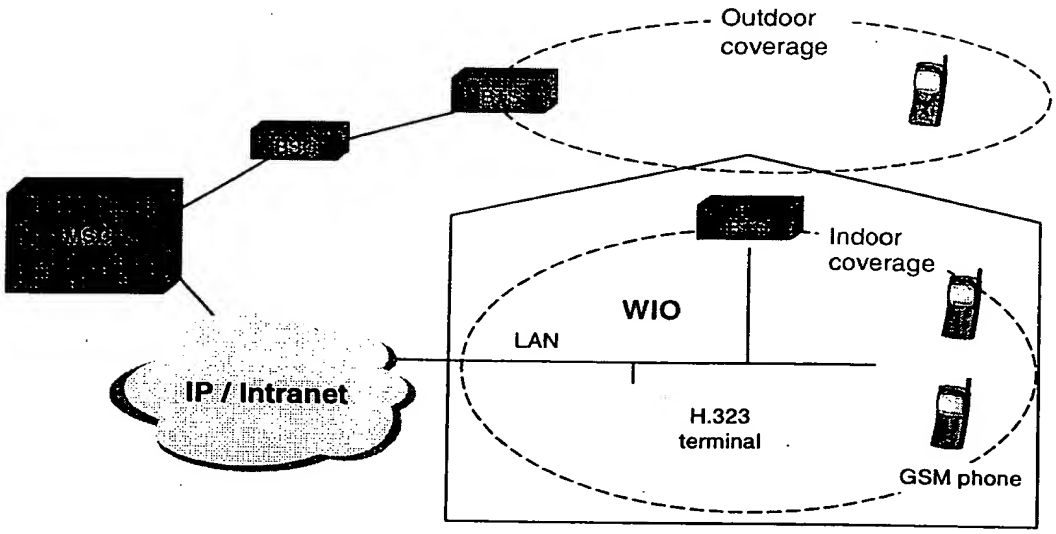
Outdoor
coverage
MSC
Indoor
coverage
WIO
LAN
IP / Intranet
H.323
terminal
GSM phone

FIG. 1.

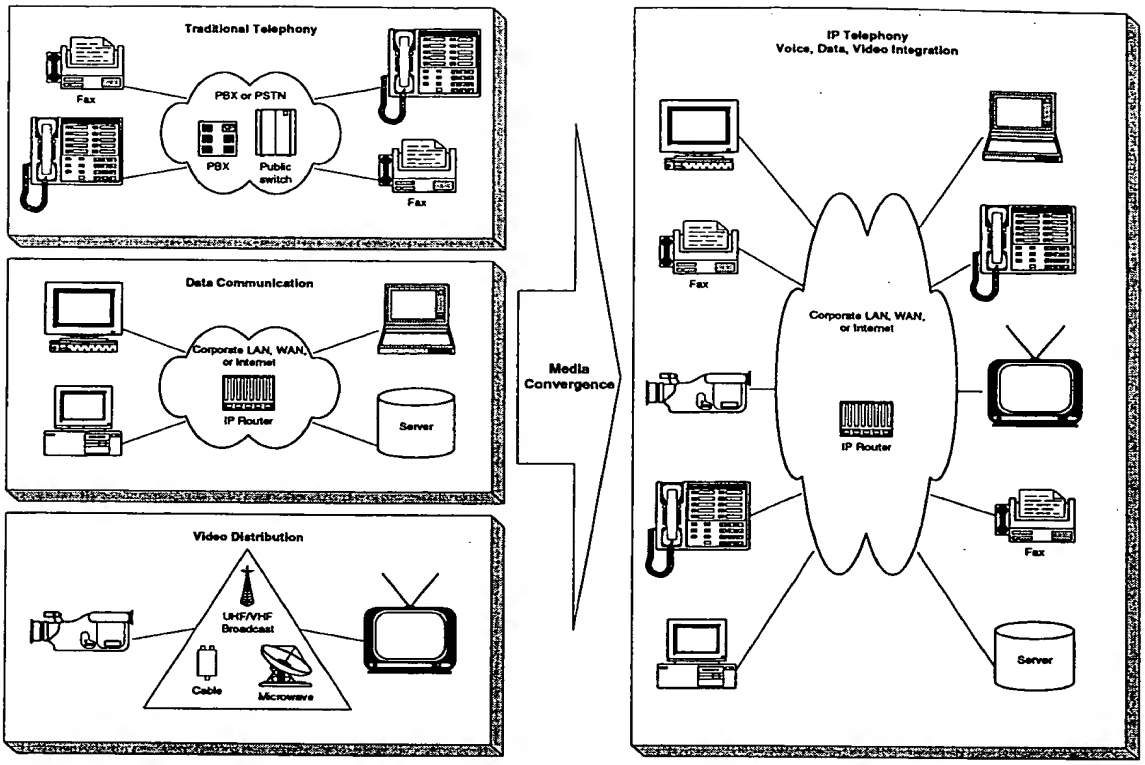
Traditional Telephony
Fax
PBX or PSTN
PBX
Public switch
Fax
Data Communication
Corporate LAN, WAN, or Internet
IP Router
Server
Video Distribution
UHF/VHF Broadcast
Cable
Microwave
Media Convergence
IP Telephony
Voice, Data, Video Integration
Fax
Corporate LAN, WAN, or Internet
IP Router
Fax
Server

FIG. 2.

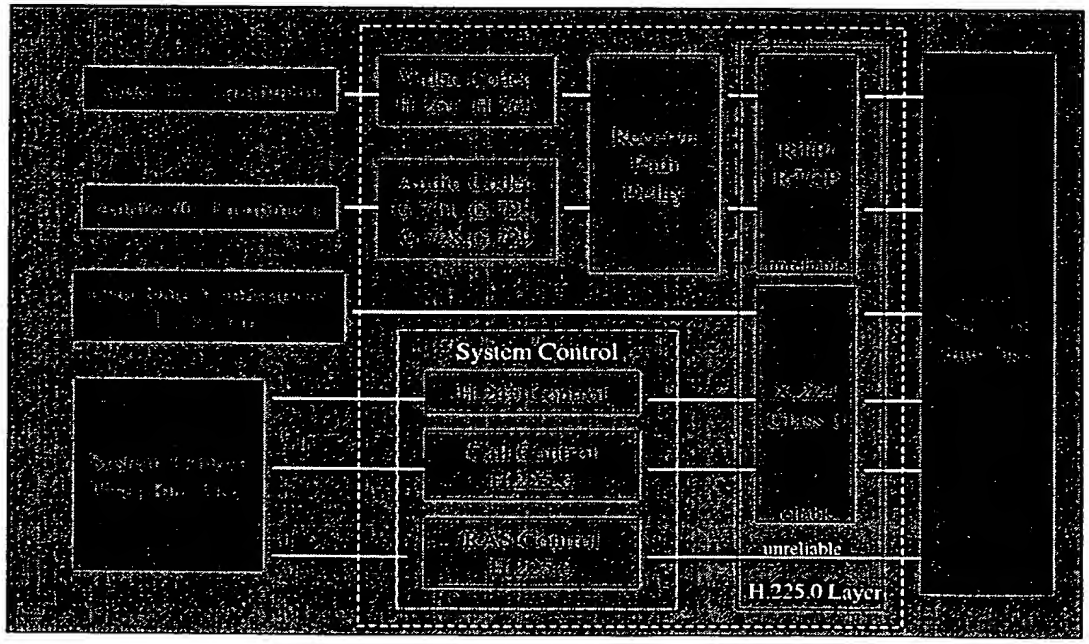
System Control
unreliable
H.225.0 Layer

FIG. 3.

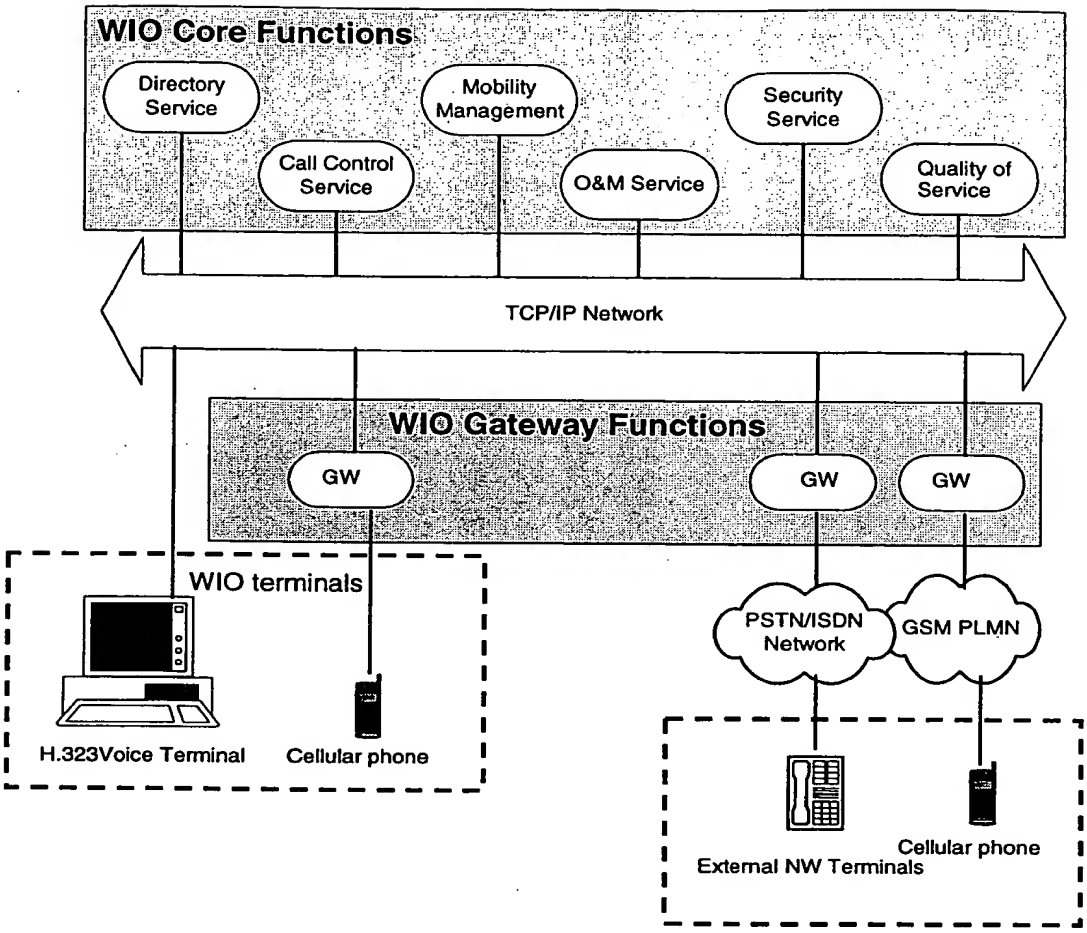
WIO Core Functions
Directory Service
Mobility Management
Security Service
Call Control Service
O&M Service
Quality of Service
TCP/IP Network
WIO Gateway Functions
GW
GW
GW
WIO terminals
H.323Voice Terminal
Cellular phone
PSTN/ISDN Network
GSM PLMN
Cellular phone
External NW Terminals

FIG. 4.

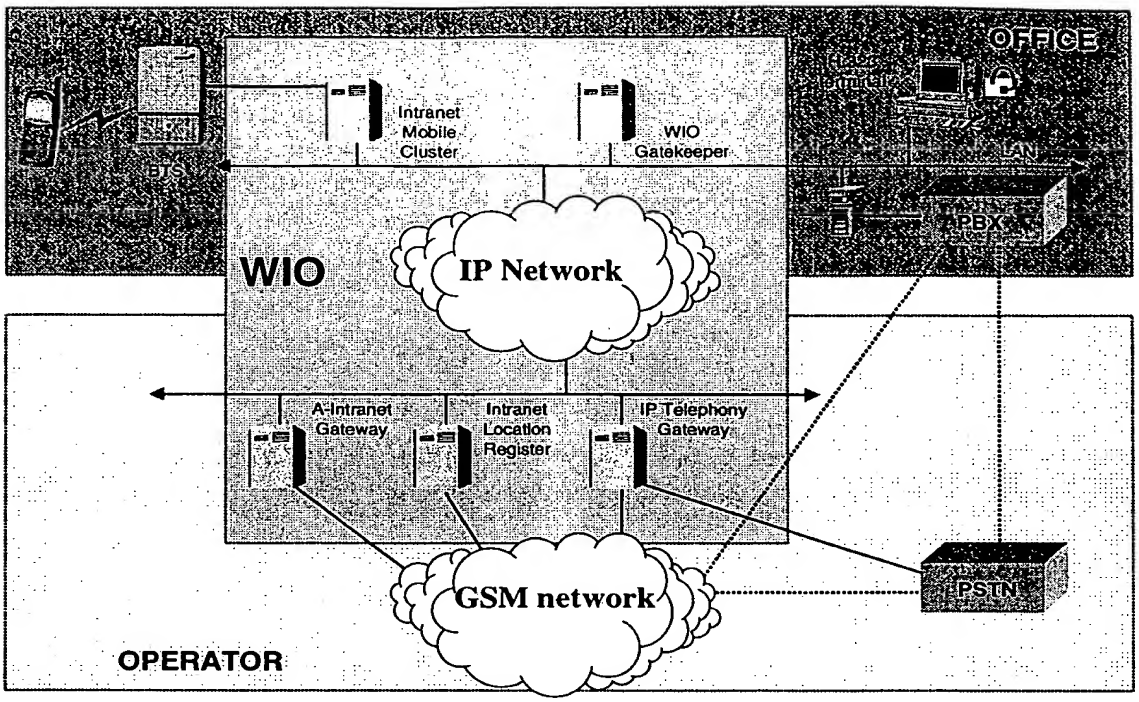
OFFICE
Intranet
Mobile
Cluster
WIO
Gatekeeper
LAN
BTS
APBX
WIO
IP Network
A-Intranet
Gateway
Intranet
Location
Register
IP Telephony
Gateway
GSM network
PSTN
OPERATOR

FIG. 5.

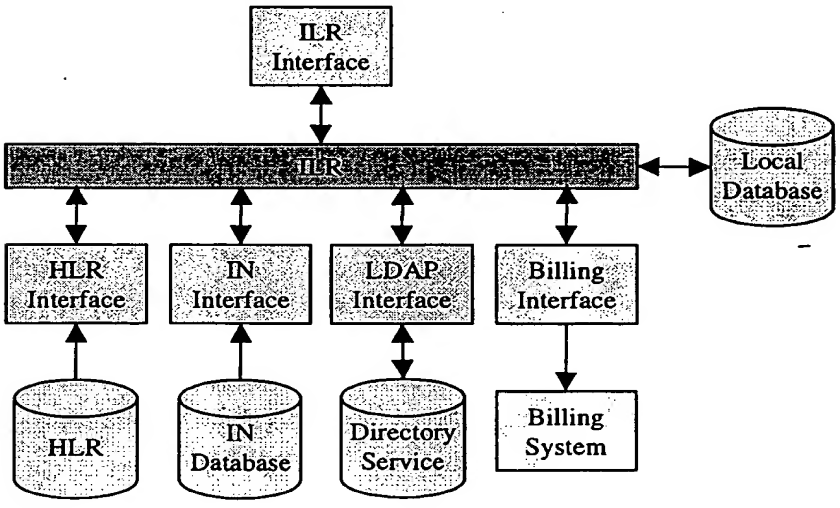
ILR
Interface
ILR
Local
Database
HLR
Interface
IN
Interface
LDAP
Interface
Billing
Interface
HLR
IN
Database
Directory
Service
Billing
System

FIG. 6.

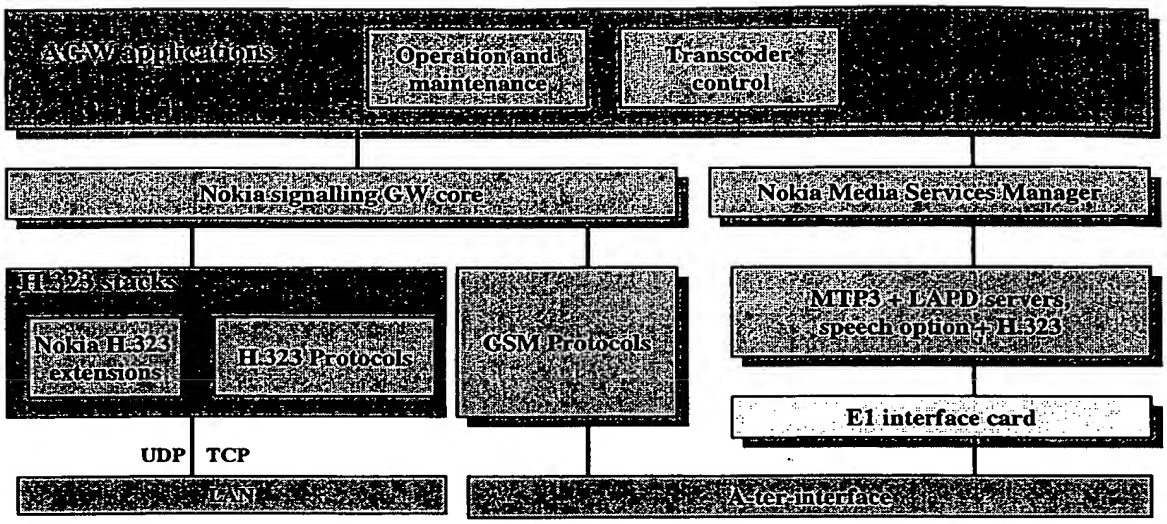
AGW applications
Operation and maintenance
Transcoder control
Nokia signalling GW core
Nokia Media Services Manager
H.323 stacks
Nokia H.323 extensions
H.323 Protocols
GSM Protocols
MTP3 + LAPD servers, speech option + H.323
E1 interface card
UDP
TCP
LAN
A-ter interface

FIG. 7.

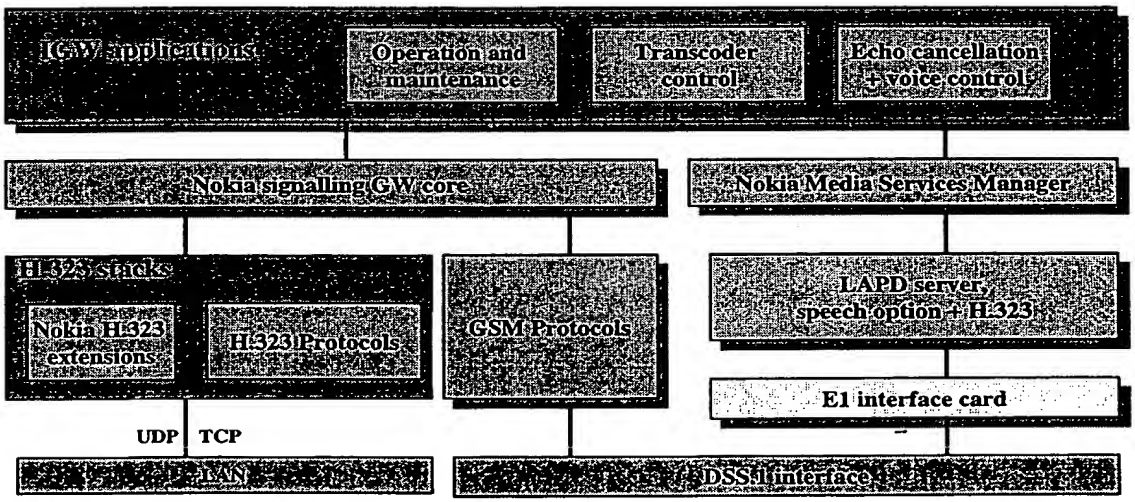
IGW applications
Operation and maintenance
Transcoder control
Echo cancellation + voice control
Nokia signalling GW core
Nokia Media Services Manager
H.323 stacks
Nokia H.323 extensions
H.323 Protocols
GSM Protocols
LAPD server, speech option + H.323
E1 interface card
UDP
TCP
LAN
A/Abis interface

FIG. 8.

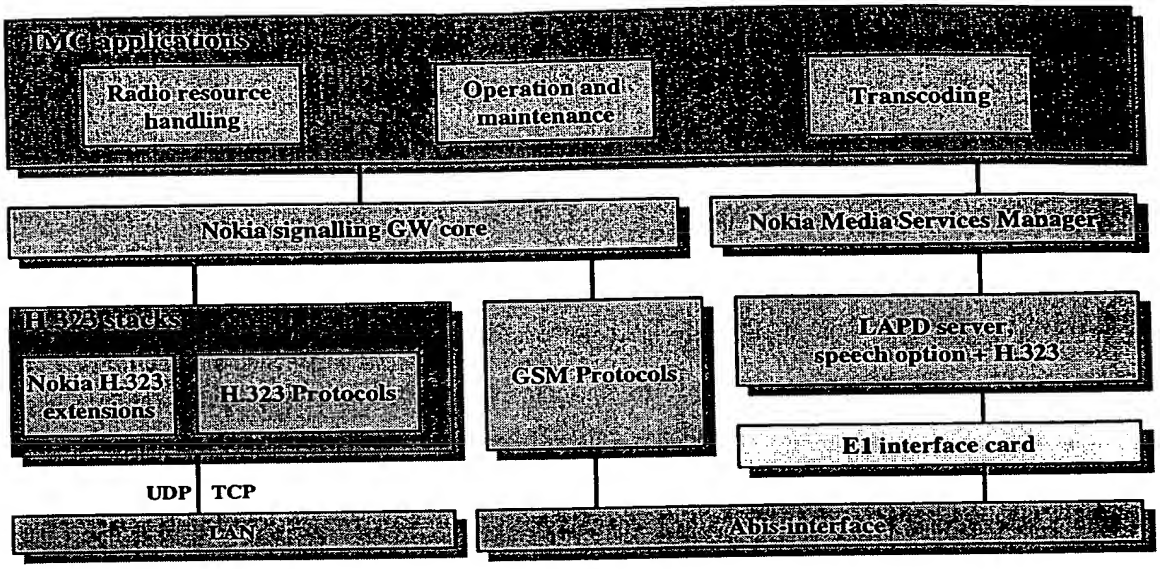
IMC applications
Radio resource handling
Operation and maintenance
Transcoding
Nokia signalling GW core
Nokia Media Services Manager
H.323 stacks
Nokia H.323 extensions
H.323 Protocols
GSM Protocols
LAPD server, speech option + H.323
E1 interface card
UDP
TCP
LAN
Abis-interface

FIG. 9.

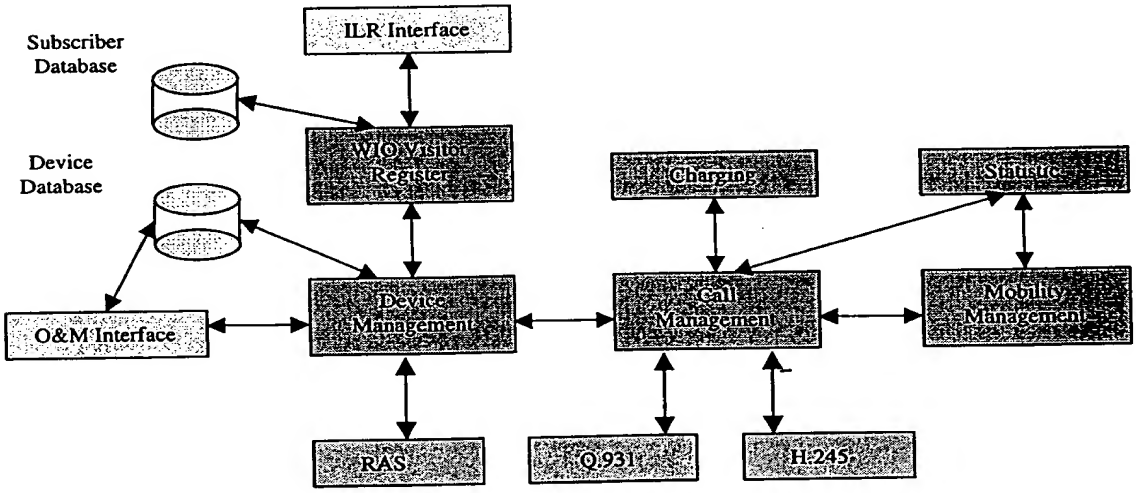
Subscriber Database
ILR Interface
Device Database
WLO Visitor Register
Charging
Statistic
O&M Interface
Device Management
Call Management
Mobility Management
RAS
Q.931
H.245

FIG. 10.

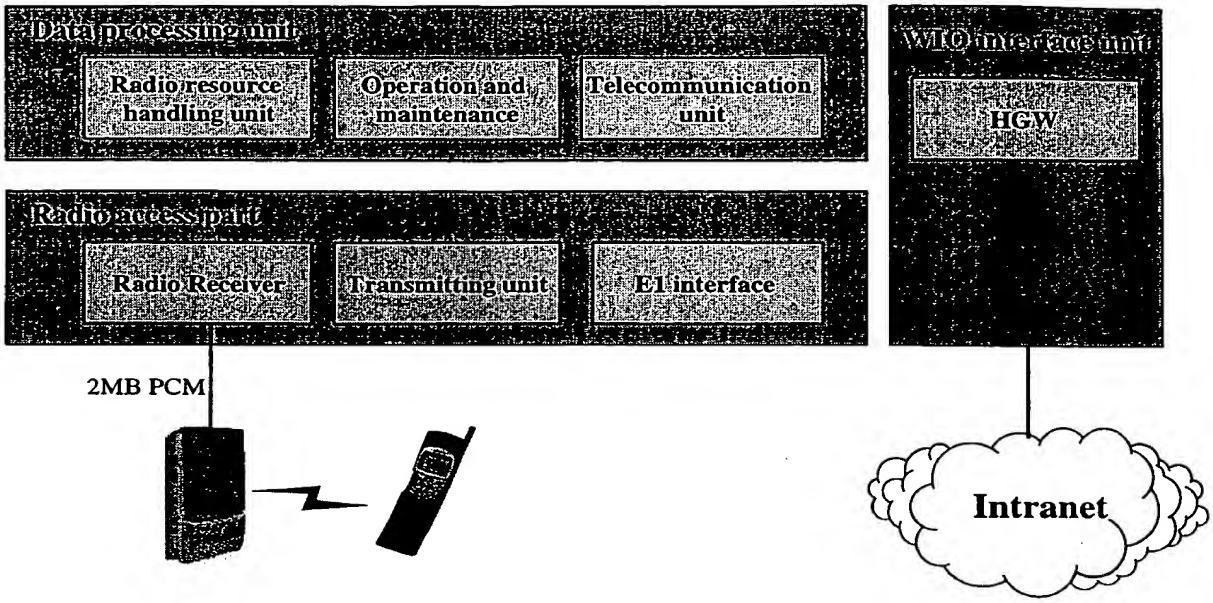
Data processing unit
Radio resource handling unit
Operation and maintenance
Telecommunication unit
WIO interface unit
HGW
Radio access part
Radio Receiver
Transmitting unit
E1 interface
2MB PCM
Intranet

FIG. 11.

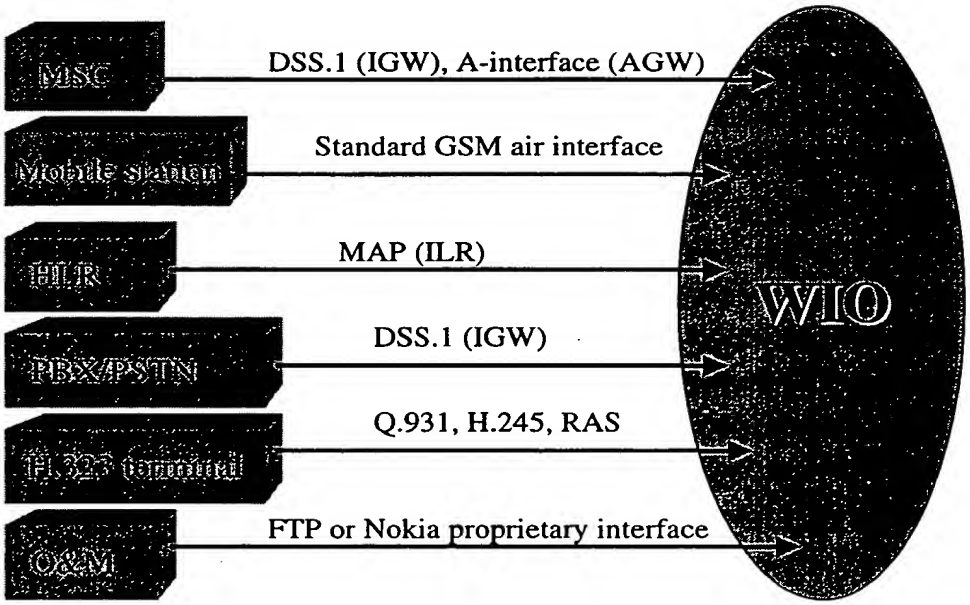
MSC
DSS.1 (IGW), A-interface (AGW)
Mobile station
Standard GSM air interface
HLR
MAP (ILR)
WIO
PBX/PSTN
DSS.1 (IGW)
H.323 terminal
Q.931, H.245, RAS
O&M
FTP or Nokia proprietary interface

FIG. 12

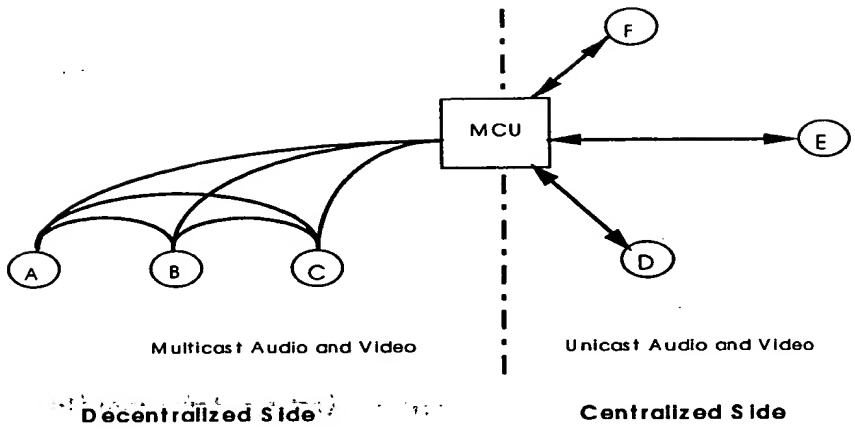
F
MCU
E
D
A
B
C
Multicast Audio and Video
Unicast Audio and Video
Decentralized Side
Centralized Side

FIG. 13.

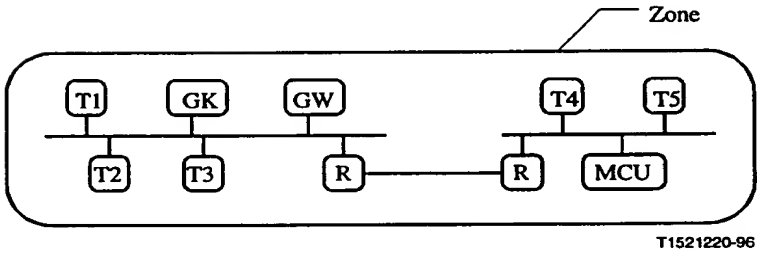
Zone
T1
GK
GW
T4
T5
T2
T3
R
R
MCU
T1521220-96

FIG. 14.